DOCUMENT RESUME

ED 052 923 SE 010 184

AUTHOR	Snyder, William R.; Kellogg, Theodore M.
TITLE	Preliminary Analysis of Teacher Factors with ISCS Student Achievement.
INSTITUTION	Florida State Univ., Tallahassee. Dept. of Science Education.
SPONS AGENCY	National Science Foundation, Washington, D.C.; Office of Education (DHEW), Washington, D.C.
REPORT NO	TR-4
PUB DATE	31 Aug 70
CONTRACT	OEC-2-6-061762-1745
NOTE	27p.
EDRS PRICE	EDRS Price MF-$0.65 HC-$3.29
DESCRIPTORS	*Academic Achievement, *Effective Teaching, Evaluation, Science Education, *Secondary School Science, *Teacher Characteristics, *Teacher Evaluation
IDENTIFIERS	Intermediate Science Curriculum Study

ABSTRACT

This research consists of an examination of the relationship of teacher characteristics to student achievement during the field testing of experimental Intermediate Science Curriculum Study (ISCS) materials. Two approaches were used in determining the characteristics of effective ISCS teachers. In the first approach the variables commonly considered as affecting student achievement were examined and analyzed to determine their relationship to student achievement on ISCS tests. The second approach involved comparing the characteristics of the group of ISCS teachers classified as being most effective with the group classified as least effective. Results indicate that effective ISCS teaching was not related to the grade level taught, to the number of science hours studied by the teacher, to the number of physical science hours studied, or to the highest degree earned. There seemed to be a close relation between teaching performance and the extent of experience with the ISCS program. Observational data indicate that teachers who let students self-pace were likely to be more successful than teachers who did not. (PR)

ED052923

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
OFFICE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY.

SEP 21 1970

PRELIMINARY ANALYSIS OF TEACHER FACTORS WITH ISCS STUDENT ACHIEVEMENT

TECHNICAL REPORT 4

ISCS

SUPPORTED BY USOE CONTRACT OEC 2-6-061762-1745 AND NSF GRANT GW-4235

THE FLORIDA STATE UNIVERSITY

SE 010 184

ED052923

TECHNICAL REPORT IV
PRELIMINARY ANALYSIS
OF TEACHER FACTORS WITH ISCS
STUDENT ACHIEVEMENT

PREPARED BY

William R. Snyder
Theodore M. Kellogg

August 31
1970

The research reported herein was performed under USOE Contract OE 2-6-061762-1745 from June, 1966 to August, 1970, and supported by The National Science Foundation Grant GW 4235.

This document has been approved for public release and sale; its distribution is unlimited. Reproduction in whole or in part is permitted for any purpose by the United States Government. Copies may be obtained from the Intermediate Science Curriculum Study, Florida State University.

INTERMEDIATE SCIENCE CURRICULUM STUDY
DEPARTMENT OF SCIENCE EDUCATION
FLORIDA STATE UNIVERSITY
TALLAHASSEE, FLORIDA

FOREWORD

The ISCS Technical Report Series is one means of communicating with other colleagues and interested professionals who are actively concerned with research and development of curriculum material. The rationale for the Technical Report series is three-fold: first, to report in a concise, descriptive, and explanatory nature advances made in the technology of curriculum development; second, to give quick distribution to pilot studies which show great promise and potential for further research and subsequent reporting; third, to provide for distribution of pre-publication copies of implementation studies that, after proper technical review, will ultimately be found in professional journals.

In considering this report, the reader is encouraged to keep in mind that this is a preliminary examination of the relationship of teacher characteristics to student achievement in the field trial of experimental ISCS material. The analysis was undertaken using pre-existing data not gathered expressly for such a purpose. The intended function of the analysis was to provide useful information to ISCS staff in developing preliminary plans for teacher education modules as well as to explore selected factors worthy of future evaluation.

Ernest Burkman, Director
Intermediate Science Curriculum Study

August 31, 1970
The Florida State University
Tallahassee, Florida

GENERAL BACKGROUND ON THE INTERMEDIATE SCIENCE CURRICULUM STUDY

The Intermediate Science Curriculum Study (ISCS) is a large-scale instructional research project supported to date by a contract with the United States Office of Education and grants from the National Science Foundation. The project is designed to develop, test, and disseminate a system of individualized science instruction for grades seven through nine.

The project is organized on a develop-field-test-revise design. Draft materials are produced at Florida State University by on campus and invited off campus personnel and tested on a large national sample of junior-high school students. During the 1969-70 school year, more than 75,000 students in 22 states have been involved in the field testing of the ISCS materials. In addition, a small number of students from the Florida State University campus school used a computer-assisted instruction version of the materials. Additional feedback data from that program has been accumulated. To date, more than 400 scientists, teachers, and education specialists have cooperated in the development process.

A unique feature of the ISCS materials is that the students using them progress at different rates, following different instructional pathways depending upon their interests, abilities, and previous experiences. The materials are being designed so that this can be accomplished in ordinary science classrooms by teachers with limited special training.

The package of instructional materials for each grade level consists of student printed materials, especially designed laboratory apparatus, a student self-evaluation system based upon behavioral objectives established for the instructional materials, teacher orientation materials, and standardized tests. The Silver Burdett Company, in conjunction with Damon Educational Corporation, is distributing these materials during the experimental phase of the project and will market the commercial versions.

The project has generated world-wide interest the newsletter, published twice yearly, now goes to more than 10.000 people in 42 countries. ISCS materials are in use in Australia and will be used in American dependent schools in Germany and Japan in September. Experimental testing of the materials is underway in Manila, and plans have been established for a joint Florida State University-Philippines effort to produce a special Philippines version of the program. In addition, project personnel have visited Japan, India, and several South American countries for preliminary discussions related to possible use of the materials in these areas.

TABLE OF CONTENTS

FOREWORD II

GENERAL BACKGROUND ON THE INTERMEDIATE SCIENCE CURRICULUM STUDY III

LIST OF TABLES V

TEACHER CHARACTERISTICS AND STUDENT ACHIEVEMENT IN ISCS 1
- The ISCS Achievement Tests 2
- The Dependent Variable 3
- The Independent Variables 3

TEACHER CHARACTERISTICS AND STUDENT ACHIEVEMENT 4
- Grade Level Taught 6
- Hours of Physical Science and Total Science Hours 8
- Years Experience Teaching ISCS 9

COMPARING MOST EFFECTIVE AND LEAST EFFECTIVE TEACHERS 10

IMPLICATIONS FOR TEACHER EDUCATION 15

APPENDIX A
- Grade 7 Teachers, Characteristics and Their Student's CTMM and ISCS Means

APPENDIX B
- Grade 8 Teachers, Characteristics, and Their Student's CTMM and ISCS Means

LIST OF TABLES

TABLE I -- Summary of ISCS Achievement Test Characteristics 2

TABLE II -- Summary of Teacher Characteristics 5

TABLE III -- Summary of Covariance Analysis 7

TABLE IV -- Achievement of Student's of Most and Least Effective Teachers 11

TABLE V -- Number of High-effective and Low-effective Teachers with Specific Characteristics 13

TABLE VI Other Characteristics of High and Low-effective Teachers 13

TEACHER CHARACTERISTICS AND STUDENT ACHIEVEMENT IN ISCS

The Intermediate Science Curriculum Study has recently undertaken the development of a set of teacher-education materials to be used in the implementation of the project's three-year sequential program for individualized science instruction. During the development and subsequent evaluation of the student materials, it has become increasingly clear that the teacher plays a critical role in implementing the individualized instructional scheme of the program. This role requires a drastic shift from a lecture-discussion-instructional orientation.

In his unique role, the ISCS teacher has primary responsbility to individual students and small groups as the instructional coordinator, content and process consultant, inquiry specialist, and key evaluator. Carrying out these new roles requires the teacher to be aware of and to possess a repetoire of characteristics crucial to successful development of an inquiry environment in which individuals may progress at their own rate.

Identifying these key teacher characteristics (factors) is s a significant task for ISCS in developing teacher training materials. Measuring the effects of a variety of such characteristics on student progress is even more difficult. This report is a first attempt at describing the effect of rather obvious teacher characteristics on student achievement in ISCS.

In the study described, two approaches were used to determine the characteristics of effective ISCS teachers. The first approach examined teacher variables commonly considered as affecting student achievement.

This approach was designed to determine the relationship of these teacher variables to student achievement on ISCS tests.

The second approach involved selecting two groups of ISCS teachers classified as most effective and least effective and then comparing the characteristics of these groups. Teachers assigned to the most effective group were those whose students scored in the top quartile on the ISCS Achievement Test. The least effective teachers were those whose students scored in the lowest quartile on the achievement test.

In both approaches, achievement on ISCS tests served as the criterion of teacher effectiveness it is appropriate to provide some specific information about these tests and their administration.

The ISCS Achievement Tests

ISCS has produced comprehensive achievement tests to be administered at the conclusion of each volume of its curriculum materials. The appropriate-level tests of student achievement have been administered to all ISCS experimental classes* since the beginning of the project evaluation in 1966. During the 1968-69 school year students in grade seven took the ISCS Achievement Test for Volume I in June, while students in grade eight took the ISCS Achievement Test for Volume II in February and the Volume III test late in the spring. The characteristics of these three tests are shown in Table I below.

	Grade	Maximum possible score	Mean	SD	Number of Students
Volume I	7	44	23.5	7.6	3414
Volume 2	8 winter	40	23.9	7.5	3092
Volume 3A-3B	8 spring	45	24.2	8.5	3086

TABLE I - Summary of ISCS Achievement Test Characteristics

*ISCS experimental classes are those classes sponsored by ISCS in Florida, (Sarasota) New Hampshire, Illinois, Iowa, Indiana, and at the University School of Florida State University.

The mean achievement on each test is approximately half of the maximum possible score. The standard deviations (SD) indicate a reasonable distribution of scores about each mean. The total distribution for each test approximates the normal curve.

The Dependent Variable

Because pre-testing was done only with a few of the trial teachers, gain scores are not available for use as a dependent variable. Post-test scores on the achievement tests serve as the dependent variable in both parts of this study. The use of these test scores as a dependent variable does not mean that these tests measure all the changes in student performance which may result from the use of ISCS curricula. The tests are a representative sampling of student content knowledge and of student ability to apply certain scientific processes. The content and processes sampled by the tests are those which can be evaluated using four response multiple-choice type items.

ISCS has administered other tests such as the Test of Understanding Science, the California Test of Mental Maturity (CTMM), the Metropolitan Advanced Arithmetic tests, and the Cooperative Reading Tests. The results of these tests provide base-line data for group comparisons and for identifying changes in student performance in areas other than ISCS content and process achievement.

The Independent Variables

Since the purpose of this study was to determine what effect, if any, different teacher characteristics (factors) had on student achievement, these teacher characteristics became the independent variables for the analysis.

Forty two seventh grade and forty-one eighth grade teachers were used in the study. All teachers selected were ISCS field-trial teachers. Each teacher provided data for his classes on the California Test of Mental Maturity and on the appropriate Level I (7th grade) or Level II (8th grade) ISCS Achievement Test. ISCS trial teachers who were unable to administer one of the tests, who did not receive the tests, who administered the tests improperly, or who failed to return the tests to ISCS were not included in the study.

In the fall of 1968, each teacher in the field-trial centers completed a brief questionnaire about his educational background and experience. On the basis of this questionnaire, teachers were classified as to 1) the grade level they taught, 2) the total number of science hours completed, 3) the number of physical science hours completed, 4) the degree earned, and 5) years of teaching ISCS. Each teacher was also observed in the classroom by an ISCS staff member. Based on this observation, the teachers was rated on a three point scale of effectiveness in classroom organization. Table II shows the descriptive statistics for each of the measured teacher characteristics.

Teacher Characteristics and Student Achievement

To determine whether or not the teacher characteristics listed in Table II (next page) have any effect on student achievement, it was necessary to adjust the ISCS Achievement Test scores for each teacher's students. This adjustment was necessary because of 1) the considerable variance in the mean CTMM scores of different teachers' students, and 2) a correlation of the ISCS Achievement Tests to the CTMM of approximately .70*

*Unpublished data analysis run at ISCS, Florida State University.

	Number of Seventh Grade Teachers	Number of Eighth Grade Teachers	Range of Teachers' Hours
1. Grade level taught			
7th	29		
7th & 8th	13	14	
8th		25	
2. Total number of science hours			
0-30	4	4	Maximum hours 8th-70
31-79	32	27	Minimum hours 8th- 0
80+	6	8	Maximum hours 7th-60
			Minimum hours 7th- 0
3. Number of physical science hours			
0-10	13	8	
11-29	20	23	
30+	9	8	
4. Highest degree earned			
Bachelors	33	30	Maximum hours 8th-123
Masters	9	9	Minimum hours 8th- 16
			Maximum hours 7th-130
5. Years teaching ISCS			Minimum hours 7th- 12
one	14	8	
two	11	18	
three	17	13	
6. Classroom organization			
poor	4	4	
fair	20	18	
good	18	17	

Note: See the appendix for complete data tables of the above

N= 42 N= 39

Table II
Summary Of
Teacher Characteristics

The ISCS Achievement Test scores were adjusted using the BMDO4V covariance analysis program. The BMDO4V program was also used to complete the analysis for the first part of the study as described in this section.

Each teacher in the study was assigned the mean CTMM score of his students as the covariate. The dependent variable was the mean score of a teacher's students on the respective ISCS Achievement Test. A separate analysis was run for each of the ISCS Achievement Tests (Volumes I, II, III). A fourth analysis combined the total scores of Volumes II and III tests. Means, ($\bar{x}$) adjustment means, (adj.$\bar{x}$) and the F level of these analyses are summarized in Table III (p. 7). A discussion of the findings for each of the six independent variables follows.

Grade Level Taught

When ISCS teachers were classified as to whether or not they were teaching seventh-grade ISCS only, eighth-grade ISCS only, or seventh and eighth-grade ISCS simultaneously, no statistically significant differences were found in student achievement. However, eighth graders whose teachers were teaching only Level II of ISCS scored higher than the students whose teachers were teaching both Level I and II of ISCS.

It seems reasonable to suppose that if a teacher is responsible for simultaneous preparation for two grade levels of ISCS, he would not be as well prepared for either grade as he would be if he had responsibility for only one grade level. However, several factors suggest limitations of this reasoning. No data were available as to the teachers' course and subject loads for classes other than ISCS. Thus, teachers classified as teaching only one level of ISCS may actually have had three other non-ISCS preparations. At the same time, a teacher who taught both ISCS levels may not have been responsible for any other preparations.

	Vol. 1 Post-test			Vol. 2 Post-test			Vol. 3 Post-test			Total Score - Vol. 2 & 3 Post-test		
	$\bar{x}$	adj.$\bar{x}$	F	$\bar{x}$	adj.$\bar{x}$	F	$\bar{x}$	adj.$\bar{x}$	F	$\bar{x}$	adj.$\bar{x}$	F
Grade level taught												
Teaches Only 7th or 8th	22.78	23.06	.000	23.76	23.74	2.024	24.12	24.02	1.951	47.97	48.09	2.553
Teaches Both 7th and 8th	23.68	23.04		22.57	22.60		22.38	22.53		45.39	45.18	
Highest Degree Earned												
Bachelors	22.90	22.95	.235	23.13	23.01	1.86	23.20	23.17	1.086	46.70	46.59	.887
Masters	23.63	23.44		23.87	24.23		24.40	24.49		48.22	48.58	
Hrs. of Physical Science												
less than 11	22.91	22.69	.818	21.46	22.41	1.571	22.28	23.44	1.309	43.73	46.08	1.354
11 to 29	23.63	23.60		23.78	23.21		23.57	22.93		47.87	46.38	
30 or more	22.01	22.39		23.76	24.54		24.23	25.17		47.99	49.94	
Total Number of Science Hours												
less than 31	24.13	22.17	.764	23.06	24.17	.739	23.29	24.53	.309	46.35	48.93	.471
31 to 79	22.73	22.96		23.55	22.98		23.80	23.20		47.80	46.42	
80 or more	24.09	24.18		22.63	24.07		22.65	23.89		44.90	48.21	
Classroom Organization												
Poor	22.67	22.91	3.133	21.65	20.59	2.996	21.76	20.56	1.749	43.38	41.31	2.637
Fair	21.56	22.06		23.57	23.41		23.78	23.51		47.47	47.30	
Good	24.81	24.20		23.44	23.82		23.49	24.02		47.47	48.14	
Years Teaching ISCS												
one	21.76	21.78	5.044	21.19	21.07	4.939	22.02	21.86	1.119	43.21	43.10	3.033
two	21.74	22.49		23.84	23.83		23.94	23.73		47.75	47.54	
three	24.98	24.48		23.86	23.95		23.63	23.94		48.44	48.79	
	N = 42			N = 40			N = 41			N = 39		

Table III
Summary of Covariance Analysis

It was not determined whether team-teaching or shared responsibility for preparation of materials might have had its effect. Unknown previous experience with a specific ISCS level would affect the preparation load of a teacher. Therefore in investigating further the effect of grade level taught, additional data should be gathered on teacher loads.

Highest Degree Earned

When teachers were grouped according to the highest degree earned, no statistically significant difference was found in the mean achievement of their students on the ISCS tests. Yet, for all levels of ISCS tests (Levels I, II, III, and II and III) mean scores and adjusted mean scores were higher for the students whose teachers held a Master's degree.*

Hours of Physical Science and Total Science Hours

The classification of teachers by the number of hours of science courses for which they had credit was intended to define three broad groupings. These groups were teachers with a few hours of science (less than 30 hours), teachers with a moderate amount (30-80 hours), and teachers with lots of science (80 hours or more). No attempt was made to adjust quarter hours to semester hours, or to arrive at some other equivalence. Rather, all reported hours were considered to be equal in weight. When teachers were classified according to the number of hours of physical science or total science they had experienced, no statistical differences were found in the achievement of their students on the ISCS tests. Neither the mean scores nor the adjusted mean scores varied in a consistent manner.

*No attempt was made in this analysis to determine either the type of Master's degree (education or science) or the recentness of the degree.

Although the mean achievement of students whose teachers demonstrated good classroom organization was not significantly different from the mean achievement of students whose teachers demonstrated poor classroom organization, there were consistent differences. The mean achievement of the students of better organized teachers at each ISCS level were higher than the mean achievement of students whose teachers demonstrated poor classroom organization (when achievement scores are adjusted for the general intelligence level of the students).

This result is in accordance with what we would expect. ISCS has stated in its experimental teacher education manual Preparing the ISCS Teacher:

> "Every ISCS teacher must devise some way of storing his equipment that will allow students working simultaneously on several activities to locate quickly the equipment they need, to collect the items with a minimum of interference with other students, and to return the equipment after use to its proper place. . . . It is absolutely essential that the beginning ISCS teacher consider this problem and take action to solve it prior to the first day of school."

The better organized teacher has more time to teach than his less organized counterpart.

Years Experience Teaching ISCS

Although no data were available as to the total teaching experience of the ISCS teachers, we were able to classify them according to the years experience they had teaching ISCS. The most pronounced differences (significant at the .05 level) were among those who had three years ISCS experience. This significant difference is also noted using the achievement scores for Volume II test Level II as the criterion. The difference drops below the significance level (.05) for the Volume III test although the direction of the difference is the same.

In grade seven there was an increase in student performance with increase in the teacher's ISCS teaching experience. In Level II, an improvement in student performance occurred mainly as teachers had a second year of experience. A third year of teaching ISCS added little to Level II student achievement. This Level II effect is logical in terms of the ISCS field trial. No ISCS teacher could have had more than two years' experience teaching ISCS Level II because all ISCS three-year teachers in Level II would have had their first year's ISCS experience teaching Level I in the 1966-67 academic year.

The analysis shows clearly that experience in teaching ISCS is significantly related to a teacher's effectiveness. Classroom organization, which should improve with increased teaching experience in ISCS, appears to be related to a teacher's effectiveness. None of the other teacher variables were shown to be significantly related to student achievement.

Most of the teacher characteristics investigated in this study apparently have no significant effect on overall achievement. However, it is possible that the effects are too subtle to measure when a whole range of teachers are pooled. Would differences in the effect of the identified teacher characteristics show up if there was a comparison made between the most effective and least effective teachers? The purpose of the following section of the study described in this report was to investigate that question.

Comparing Most Effective and Least Effective Teachers

In order to identify the most and least effective teachers, the following procedure was used. The means for the CTMM tests and ISCS achievement tests of each teacher's students were computed. The linear regression of ISCS achievement test scores to CTMM test scores was used to predict an ISCS

Achievement Test score for every CTMM mean. Once a predicted ISCS score was calculated for each teacher, this predicted score was compared with the mean ISCS score actually achieved by the students of that teacher. The teachers whose students mean achievement scores exceeded their predicted scores by the largest amount were identified as the most effective teachers, while the teachers whose students' mean scores fell farthest below their predicted scores were considered the least effective teachers. The BMD02R program was used to calculate both the predicted scores and the difference between the predicted score and the ISCS test scores. The same procedure was followed for each of the ISCS Achievement Tests.

Once the two groupings had been made, the mean achievement scores of the students from each group were compared.

Table IV shows the differences in the achievement of students of the teachers classified as most and least effective. Note that all differences are highly significant. The estimate of the ISCS achievement score is based on the CTMM score, yet major deviations occur from the estimate.

	Vol. 1		Vol. 2		Vol. 3	
	high	low	high	low	high	low
ISCS Test Predicted Score (from CTMM)	23.70	23.50	23.47	22.80	23.91	23.67
ISCS Test Score (achieved)	27.18	20.12*	26.57	19.88*	28.92	19.42*

*Significant difference between groups at the .001 level.

Table IV

The first step in comparing the characteristics of the most effective and least effective teachers was an examination of the two groups in terms of the same six independent variables used in the first part of the study---grade level taught, highest degree earned, total number of science hours, hours of physical science, years teaching ISCS, and classroom organization. In each comparison, the dependent variable was student scores on an ISCS achievement post-test. A summary of these comparisons is given in Tables V and VI.

Data in Table V show that the most effective teacher tends to be better organized and to have taught ISCS longer. Grade level taught and highest degree earned are not significantly related to teacher effectiveness.

The data in Table VI show no consistent pattern of differences between the most and the least effective teachers in regard to either the total number of science hours studied or the number of physical science hours studied. It is of interest to note that the more effective teachers in Level II have more hours of physical science than the less effective teachers in Level II, but this difference is not statistically significant.

	Vol. 1		Vol. 2		Vol. 3	
	High	low	high	low	high	low
Grade Levels Taught						
7th or 8th	7	7	8	5	7	6
7 and 8	3	3	2	5	3	4
Highest Degree Earned						
Bachelors	7	9	6	9	6	8
Masters	3	1	4	1	4	2
Organization						
1 poor	1	2*	0	2	0	2
2 fair	1	6	4	4	4	5
3 good	8	2	6	4	6	3
Years Teaching ISCS						
1 year	1	7*	1	2	1	4
2 years	1	1	6	4	4	4
3 years	8	2	4	4	5	2

*Difference is significant at the .01 level by the Mann Whitney U Test

Table V

Number of High-effective and Low-effective
Teachers with Specific Characteristics

	Vol. 1		Vol. 2		Vol. 3	
	high	low	high	low	high	low
Hours of Physical Science						
Mean number of hours	16.1	17.1	24.8	17.1	27.8	18.9
Maximum number of hours	43	30	37	40	70	40
Minimum number of hours	0	0	11	0	11	0
Total Hours of Science						
Mean number of hours	53.9	59.0	67.6	55.5	65.8	58.2
Maximum number of hours	90	123	114	84	114	82
Minimum number of hours	22	24	45	33	31	36

Table VI

Other Characteristics of High and Low-effective Teachers

In an attempt to describe other teacher variables which might influence the effectiveness of seventh and eighth grade teachers, the project field trial coordinator* was asked to make anecdotal comments about the selected ISCS teachers. The selected teachers were those described as most effective and least effective. The names of the teachers were presented to the field trial coordinator in a random order, and he was not aware of the "effectiveness classification" of each teacher. The field trial coordinator's anecdotal comments are summarized below:

The most effective ISCS teachers tended to:

1) have good rapport with students.
2) be located in schools with excellent physical facilities.
3) be classified as "good" teachers.
4) be hard workers.
5) understand the ISCS philosophy.
6) produce innovative classroom ideas.
7) have a good science background.

The least effective ISCS teachers tended to:

1) be overwhelmed by the job of conducting an ISCS class.
2) have difficulty adjusting to the self-pacing nature of ISCS.
3) be traditionally oriented.
4) have poor facilities and equipment shortages.
5) be new to the ISCS program.

It must be remembered that this summary of the characteristics of most effective and least effective teachers is based on observations of one classroom observer who made only one or two visits to each classroom. The lists of characteristics are presented primarily as a stimulus for those who might be interested in doing further work in identifying attributes of effective ISCS teachers.

This attempt to identify good and bad ISCS teachers revealed a situation which seemed to characterize the whole school. Where one or two excellent teachers provide guidance to a center all or most of the teachers at that

*The field trial coordinator had observed all of the ISCS teachers once or twice during the year. All visits were made on a schedule pre-arranged with the classroom teacher visited.

school are good. Unfortunately, the opposite is also true. In one school two of four seventh-grade teachers and four of four eighth-grade teachers were identified in the lists of least effective ISCS teachers. It was reported that this school lacked an effective science department leader.

Implications for ISCS Teacher Education

Even though the studies described above were preliminary in nature, they contain information relevant to the ISCS teacher education program. In summary it was found that:

> The performance of ISCS teachers seems to be closely related to the experience they have had with the program. It is likely one or more years' experience of teaching ISCS prepares the teacher to handle the problems of efficient classroom management and alerts the teacher to critical points in the materials. Observational data of the teachers indicate that teachers who are able to let students self-pace are likely to be more successful than teachers who cannot. Effective ISCS teaching was not found to be related to grade level taught, to the number of science hours studied, to the number of physical science hours studied, or to the highest degree earned.

These findings indicate that the preparation of ISCS teachers should reflect the actual ISCS classroom. A group of teachers should also be exposed to the complexities of the problems of classroom organization. If teachers experience an ISCS-type classroom both as teacher and student, they should find that it isn't necessary for someone to know what he is doing all the time. By working through student materials, teachers experience the critical points that their students are likely to stumble on. ISCS has found that experience with an individualized program is a key factor for effective teaching of the program.

Grade 7 ISCS Teachers, Characteristics and Their Student's CTMM and ISCS Means

Teacher No.	Grade	Degree	Phy. Sci. Hours	Total Hours	Org.	Years	CTMM	Vol. I Post
AA	7*	1**	24	58	1***	2****	56.02	21.95
AB	7	1	36	36	2	2	46.68	17.64
AC	7	1	27	68	3	3	54.30	23.09
AD	7	1	31	46	2	1	57.17	19.83
AE	7	2	60	76	2	2	56.27	21.70
AF	7	1	17	48	2	3	57.44	20.96
AG	7	2	17	75	2	2	52.87	19.18
AH	7	1	12	78	3	3	50.88	19.73
AI	7	1	15	55	2	1	57.60	22.58
AJ	7	1	21	54	3	3	55.48	24.03
AK	7	2	6	42	2	2	57.67	18.95
AL	2	1	24	82	3	3	0.00	0.00
AM	7	2	26	90	3	3	65.46	28.38
AN	2	1	10	60	1	3	61.70	20.47
AO	2	1	0	58	1	1	66.23	21.68
AP							65.08	24.46
AQ							52.21	17.32
AR	7	1	0	25	2	1	63.12	19.59
AS	2	1	20	66	3	2	57.53	23.40
AT	2	1	16	84	2	1	55.85	21.16
AU	7	2	20	38	3	1	65.28	22.05
AV	7	1	16	38	2	1	61.06	21.01
AW	2	1	8	50	2	2	54.30	20.74

AX	2	1	20	73	3	3	57.38	22.05
AY	2	1	16	25	3	3	59.91	0.00
AZ	7	1	9	24	3	3	72.24	22.46
BA	7	1	10	80	1	3	48.65	26.56
BB	7	1	8	57	2	1	58.84	23.61
BC	2	1	20	76	3	3	59.47	25.42
BD	7	2	30	130	3	1	57.17	22.44
BE	7	2	0	30	3	2	64.80	26.86
BF	2	2	28	76	3	2	60.09	24.74
BG	7	2	30	72	3	3	62.69	28.36
BH	7	1	10	62	2	1	40.51	14.56
BI	2	2	4	80	3	2	0.00	0.00
BJ	7	1	4	45	2	3	69.02	26.66
BK	2	1	16	57	3	2	63.41	24.37
BL	2	1	43	123	2	1	58.96	19.89
BM	7	1	35	80	2	1	66.48	26.16
BN	7	1	32	46	2	2	57.32	19.62
BO	7	1	35	43	2	1	57.82	22.41
BP	2	1	16	49	3	3	65.35	28.65
BQ	2	1	20	60	3	3	63.27	27.86
BR	7	1	8	22	2	1	59.03	27.61
BS	2	1	12	44	3	2	68.74	27.42
BT	7	1	20	58	3	3	60.89	24.59
BU							65.54	28.03
BV							62.98	27.22

* 7 = only ISCS classes are grade 7 2 = have both 7th and 8th grade ISCS classes.
** 1 = bachelor's degree 2 = master's degree
*** 1 = poor organization 2 = fair organization 3 = good organization
**** years of experience teaching an ISCS course

APPENDIX B

Grade 8 Teachers, Characteristics, and Their Student's CTMM and ISCS Means

Grade 8 ISCS Teachers Characteristics, and Their Student's CTMM and ISCS Means

Teacher No.	Grade *	Degree **	Phy. Sci. Hours	Total Hours	Org. ***	Years ****	CTMM Mean	Vol. 2 Post	Vol. 3 Post
AA	8	1	35	116	2	2	45.91	24.23	24.15
AB	8	1	11	45	2	2	46.61	27.20	27.19
AC	8	1	11	49	3	3	46.69	21.50	19.91
AD	8	1	6	39	2	3	39.07	17.16	19.72
AE	8	2	20	74	2	2	43.77	18.49	16.82
AF	8	1	26	60	2	2	45.93	20.70	19.38
AG	8	2	10	24	2	2	42.47	22.66	23.09
AH	8	1	58	88	3	3	37.87	19.05	18.57
AI	8	2	37	114	2	3	46.26	27.20	26.31
AJ	8	1	70	80	2	1	44.33	22.60	26.17
AK	8	1	8	16	3	2	40.89	21.00	21.10
AL	2	1	24	82	3	2	45.94	21.32	17.50
AM	8	2	12	33	1	1	49.69	21.75	24.63
AN	8	2	8	31	13	2	50.37	26.38	28.81
AO	2	1	10	60	1	3	46.33	23.13	19.07
AP	8	1	20	50	3	2	50.79	25.03	23.68
AQ	2	1	0	58	1	1	47.61	16.08	18.59
AR	2	1	20	36	2	1	48.81	21.21	20.16
AS	2	1	20	66	3	2	51.56	23.20	21.58
AT	8	1	10	45	2	1	50.74	24.15	24.18
AU	2	1	16	84	2	1	38.98	17.65	16.00
AV	8	1	40	56	3	2	46.99	21.03	19.61
AW	2	1	8	50	2	2	42.86	21.10	23.64

AX	2	1	20	74	3	3	44.32	0.00	19.19
AY	8	2	13	40	1	2	52.04	25.50	24.75
AZ	2	1	24	41	3	3	40.13	0.00	17.68
BA	2	1	16	25	3	2	42.51	20.26	22.41
BB	8	2	26	49	3	3	44.15	24.02	24.92
BC	2	2	18	58	3	3	45.66	22.39	22.90
BD	8	1	24	50	2	2	55.85	30.21	33.15
BE	8	1	20	53	2	3	50.50	27.08	26.50
BF	8	1	36	76	3	2	47.05	27.01	29.58
BG	2	2	28	76	3	2	41.33	24.33	0.00
BH	8	2	30	96	3	3	46.62	25.98	27.41
BI	8	1	20	54	2	3	47.55	22.74	24.82
BJ	8	1	12	61	3	1	49.41	23.08	24.41
BK	2	1	16	57	3	2	46.23	24.97	27.87
BL	2	1	43	123	2	1	48.12	23.00	22.03
BM	8	1	18	47	2	3	49.58	0.00	22.58
BN	2	1	16	49	3	3	49.94	23.63	28.93
BO	8	1	12	21	2	2	53.66	28.00	26.56
BP	2	1	20	60	3	3	48.27	27.71	31.09
BQ	2	1	12	44	2	3	59.33	28.56	30.36

* 0 = only ISCS classes were grade 8, 2 = has both 7th and 8th grade ISCS clas
** 1 = bachelor's degree; 2 = master's degree
*** 1 = poor organization, 2 = fair organization, 3 = good organization
**** = years of experience teaching an ISCS course